**Turbulent Convection and Differential Rotation Within the Sun**

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Differential rotation and cycles of magnetic activity are intimately linked dynamical processes within the deep shell of highly turbulent convection occupying the outer 200 Mm below the solar surface. Helioseismology has shown that the angular velocity $\Omega$ within the solar convection zone involves strong shear layers both near the surface and especially at its base near the interface with the radiative interior. The tachocline of radial shear there that varies with latitude is thought to be the site of the global magnetic dynamo. Most recent continuous helioseismic probing with MDI on SOHO and from GONG have revealed systematic temporal changes in $\Omega$ with the advancing solar cycle. These include propagating bands of zonal flow speedup extending from the surface to a depth of about 70 Mm, distinctive out-of-phase vacillations in $\Omega$ above and below the tachocline with a period of about 1.3 years near the equator, a changing pattern of meridional circulation cells with broken symmetries in the two hemispheres, and complex speedups and slowdowns in the bulk of the convection zone. We review these helioseismic findings and their implications. We also describe current 3–D numerical simulations of anelastic rotating convection in full spherical shells used to study the differential rotation that can be established by such turbulence exhibiting coherent structures. These simulations enabled by massively parallel computers are making promising contact with aspects of the $\Omega$ profiles deduced from helioseismology, but challenges remain.